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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Mechanical Engineering

Semester End Examination; Dec - 2016/Jan - 2017

Basic Thermodynamics

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Use of Thermodynamics data hand book is allowed.

UNIT - I

1	a.	Define the following terms : (i) Control volume (ii) Quasistatic process (iii) Zeroth law of thermodynamics (iv) Reversible process.	8
	b.	What is an adiabatic process? Derive an expression for work done in an adiabatic process.	8
	c.	Explain microscopic and microscopic point of views in the study of thermodynamics.	4
2	a.	Give the thermodynamic definition of work and heat.	4
	b.	Explain with a neat sketch an example to indicate the difference between heat and work flow.	6
	c.	Work supplied to a closed system is 160 kJ. The initial volume is V_1 = 0.8 m^3 and the pressure of the system varies P = 7 - 3v, where P is in Bar and v is in m^3. Determine the final volume and pressure of the system.	10

UNIT - II

3	a.	Define first law of thermodynamics. Show that for a closed system undergoing a cyclic process, $\Delta Q = (E_2 - E_1) + \Delta W$.	6
	b.	Define enthalpy and show that enthalpy $H = U + PV$.	6
	c.	An engine has a volume of 60 litres and a compression ratio of 14.2 to one. At the beginning of compressions stroke, the pressure and temperature are 1 Bar and 80ºC. At the end of compression process the pressure is 30 Bar. The charge is now heated at constant pressure until the volume is doubled. Determine, index of compression, temperature at the end of compression, and work done.	8
4	a.	What is steady flow process and what are the conditions to be satisfied by a steady flow process? Given an example.	6
	b.	Define specific heats, and show that $R = C_P - C_V$.	6
	c.	12 kg of air/ minute is delivered by a centrifugal air compressor. Air enters at 12 m/s and the compressed air leaves at 90 m/s. The increase in enthalpy of air passing through the compressor is 150 kJ/kg. Find the power required to drive the compressor. Also determine the ratio of inlet to outlet diameter, assuming that both pipes are at the same level.	8

Contd….2

UNIT - III

5 a. Define the following terms :

(i) Dryness fractions (ii) Two property rule 8

(iii) Sub cooled liquid (iv) Triple point of water.

b. With a neat sketch, explain temperature-volume diagram and name the salient points (water). 6

c. A throttling calorimeter is used to measure the dryness fraction of the steam in the steam main when the steam is flowing at a pressure of 6 Bar. The steam after passing through the calorimeter comes at out of 100 kPa pressure and 120ºC temperature. Calculate the dryness fraction of steam in the main. 6

6 a. With the help of neat sketch, explain the working of a combined separating and throttling calorimeter. 8

b. Sketch the temperature-enthalpy diagram for water and name the salient points. 4

c. Steam at 10 Bar and 0.95 dryness is available. Determine the final condition of steam in each of the following cases :

(i) 160 kJ of heat is removed at constant pressure

(ii) It is cooled at constant volume till the temperature inside falls to 140ºC. 8

(iii) Steam expands isentropically in a steam turbine developing 300 kJ of waste per kg of steam when the exit pressure of the steam is 0.5 bar.

UNIT - IV

7 a. Define two statements of second law of thermodynamics and comment on them. 6

b. Show that all reversible engines have the same efficiency when working between the same two reservoirs. 6

c. There are three reservoirs at temperature 827ºC, 127ºC and 27ºC in parallel. Reversible heat engine operates between 827ºC and 127 ºC and a reversible refrigerator operates between 127ºC and 27ºC respectively. 500 kJ of heat is extracted from the reservoir at 827 ºC by the heat engine and 250 kJ of heat is abstracted by the refrigerator from the reservoir at 27ºC. Find the net amount of heat delivered to the reservoir at 127ºC. Sketch the arrangement of reservoirs. 8

8 a. Define heat engine and heat pump or refrigerator. Write an expression for the efficiency of heat engine and heat pump. 6

b. What is a perpetual motion machine of second kind? Explain with neat sketch the working of PPM-II kind. 6

c. Two Carnot engines work in series in between the source and sink temperature of 550ºK and 350ºK. If both engines develop equal power determine the intermediate temperature. 8

UNIT - V

9 a. Define entropy and show that entropy is a property of the system. 6

b. Show that $T.ds = dU + Pdv$ starting from first law of thermodynamics and hence derive an expression for change in entropy. 6

c. Calculate the change in entropy of one kg of air expanding polytropically in a cylinder behind a piston from 7 bar and 600ºC to 1.05 Bar. The index of expansion is 1.25. 8

10 a. State and prove inequality of Clasusious. 6

b. State and prove principle of Increase of entropy. 6

c. 2.5 kg of air at a pressure of 2 bar and 26ºC forms a closed system; which under goes a constant pressure process. With a heat addition of 650 kJ. Find the final temperature, change in enthalpy, change in internal energy, work transfer and change in entropy. 8

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